METHOD AND DEVICE FOR DRYING CLOTHES

[001] The present invention relates to a method and a device for drying clothes.

[002] When drying laundry using a laundry dryer which comprises a rotating drum for receiving laundry, an anti-crease cycle is provided at the end of a drying program or a drying phase. A drying program usually comprises a heating-up phase, a subsequent actual drying phase and a following cooling-down phase. During all these phases belonging to a drying program, the drum is usually rotated continuously. This also applies during the cooling-down phase when the heating is merely switched off. If the dried laundry is not removed immediately from the drum at the end of a drying program, creases can be fixed in the laundry. In order to prevent this, the drum is either rotated continuously or the drum is rotated intermittently during the subsequent anti-crease cycle.

[003] As a result of the continuous rotation of the drum or as a result of the intermittent rotation of the drum during the anti-crease cycle, the laundry located in the drum is increasingly loosened so that no creases can form in the laundry. The intermittent rotation of the drum is usually effected according to a fixed pattern, such as for example stoppage of the drum for two minutes followed by rotation of the drum for fifteen seconds. This intermittent operation continues either until the end of the anti-crease cycle which can last up to three or five hours or until the time when the laundry is removed from the drum. A disadvantage with this anti-crease cycle is that the laundry is exposed to further stress through the movement of the drum. The drive motor and the switching elements for switching the drive motor on and off are also further stressed by the continuous switching-on and off.

[004] It is the object of the present invention to provide a method and a device for drying laundry which has an anti-crease cycle during which the laundry and the components of the device are treated gently, and during which crease formation is optimally avoided and energy consumption is reduced.

[005] The object is achieved with regard to the method by the features of the claims. This object is achieved with regard to the device by the features of the claims. Advantageous

embodiments and further developments of the invention are obtained from the dependent claims.

[006] In a method for drying laundry in a device comprising a rotatable drum for agitating the laundry, a drying program is followed by an anti-crease cycle, wherein the laundry is intermittently agitated.

[007] Since, in the course of the anti-crease cycle the agitation of the laundry decreases with time or since the agitation of the laundry during the anti-crease cycle decreases as the temperature of the laundry decreases and/or as the residual moisture of the laundry decreases, or since the agitation of the laundry during the anti-crease cycle is dependent on the pre-selected drying program and/or the pre-selected degree of drying and/or the pre-selected type of laundry, or since the agitation of the laundry during the anti-crease cycle is dependent on the amount of laundry preset by a user and/or the amount of laundry determined by the device, it is achieved that the laundry is only agitated sufficiently during the anti-crease cycle to avoid crease formation. As a result, the laundry is only minimally agitated or loosened during the anti-crease cycle and thus is treated very gently, whereby crease formation can be optimally avoided. Furthermore, the motor for turning the drum is switched on and off less frequently, and especially towards the end of the anti-crease cycle, the switch-on time of the drum movement is reduced substantially so that the components for the drum movement such as the motor, relays for switching the motor on and off and the drum bearing are less stressed and thus the lifetime and the reliability of the device is increased. Furthermore, energy is saved since the overall switch-on time of the drum movement during and in the course of the anti-crease cycle is substantially reduced.

[008] Since the laundry temperature and also the residual moisture is still elevated at the beginning of the anti-crease cycle, the risk of creases being fixed in the laundry is higher at the beginning of the anti-crease cycle than towards the end of the anti-crease cycle so that for optimal avoidance of crease formation, a higher proportion of agitation of the laundry is required at the beginning of the anti-crease cycle than towards the end of the anti-crease cycle. Furthermore, the proportion of agitation can be optimally matched to the pre-selected drying program or to the pre-selected degree of drying or the pre-selected type of laundry. For

example, a "damp for ironing" drying program requires an overall higher proportion of agitation than a "cupboard-dry" or "very dry" drying program. In addition, the proportion of agitation can be optimally matched to the quantity of laundry located in the drum. Thus, the proportion of agitation of the laundry can be minimised for each operating state so that the laundry and the components of the device are treated gently and the energy consumption is reduced.

[009] In an advantageous embodiment, in order to achieve these aims the agitation of the laundry during the anti-crease cycle is therefore dependent on measured quantities and parameters which are detected in preceding phases of a drying program and/or during the anti-crease cycle.

[010] In this case, measured quantities and parameters which are detected during a heating-up phase at the beginning of a drying program and/or during a cooling-down phase at the end of the drying program can also be taken into account.

[011] In an advantageous embodiment in order to achieve the preceding aims in particular, the quantity of laundry and/or the heating-up time and/or the laundry moisture and/or the laundry moisture profile and/or the laundry specific conductance and/or the profile of the laundry specific conductance and/or the moisture content and/or the moisture profile and/or the temperature of the laundry and/or the temperature profile of the laundry and/or the temperature of the drying air and/or the temperature profile of the drying air in the drum of the dryer and/or the comparison of the moisture content and/or the moisture profile and/or the temperature of the drying air and/or the temperature profile of the drying air in the drum of the dryer between entry into the drum and exit from the drum and/or the time before reaching a drying target can thus be used as measured quantities or parameters.

[012] For this purpose, the rotatable drum has rotary movement time intervals and stoppage time intervals in the anti-crease cycle. During the rotary movement time intervals the drum can be turned in one direction of rotation and/or reversingly in different directions of rotation. The duration of an anti-crease cycle is preferably one to five hours.

[013] In a preferred embodiment, the duration of the anti-crease cycle is preferably divided into four time intervals wherein in a first time interval the proportions of agitation lie between 20% and 90%, and that in a second time interval the proportions of agitation lie between 10% and 70%, and that in a third time interval the proportions of agitation lie between 1% and 60% and that in a fourth time interval the proportions of agitation lie between 1% and 30%.

[014] A device for drying laundry comprises a rotatable drum for agitating the laundry and a control device which is capable of carrying out the process steps and process sequences specified hereinbefore. For this purpose, the device has a control device with an input device and a timing element. In addition, the device has sensor devices for detecting measured quantities and parameters, which are supplied to the control device and processed in the control device according to the preceding process sequences.

[015] Furthermore, the device for drying laundry has a heater for heating the drying air, a motor for driving the drum and a fan for conveying the drying air are provided.

[016] Further details, features and advantages of the invention are obtained from the following description of an exemplary embodiment of a device according to the invention for drying laundry which is capable of carrying out the preceding process steps and process sequences with reference to the drawings.

[017]

[018] In the figures:

[019] Figure 1 is a device for drying laundry.

[020] According to Figure 1, a device for drying laundry comprises a housing 1 in which a drum 2 is rotatably mounted, a loading door 3, a front bearing plate 4, an inlet duct 5 for drying air in which a heating device 6 is located, an outlet duct 7 for drying air in which a fan 8 is located and a motor 9 which drives the drum 2 by means of a belt 10. Also provided is a control device 11 comprising an input device 12 and a timing element 13. A first temperature sensor 14 is arranged in the inlet duct 5 adjacent to the inlet to the drum 2 and a second temperature sensor 15 is arranged in the outlet duct 7 adjacent to the drum 2. Located on the front bearing plate 4 are two electrodes 16 to detect the specific conductance of the laundry and/or the drying air. The first temperature sensor 14, the second temperature sensor 15 and the electrodes are connected to the control device 11 which is capable of processing signals from the sensors and the input device 12. The device for drying laundry described hereinbefore can also be constructed as an exhaust air dryer or a condensation dryer.

[021] The device for drying laundry as shown in Fig. 1 can be provided with further sensors such as laundry temperature sensors or the like in order to carry out the process sequences and process steps described hereinafter.

[022] The process sequences and process steps described hereinafter can be carried out using the device for drying laundry described hereinbefore.

[023] Since, in the course of the anti-crease cycle the agitation of the laundry decreases with time or since the agitation of the laundry during the anti-crease cycle decreases as the temperature of the laundry decreases and/or as the residual moisture of the laundry decreases, or since the agitation of the laundry during the anti-crease cycle is dependent on the pre-selected drying program and/or the pre-selected degree of drying and/or the pre-selected type of laundry, or since the agitation of the laundry during the anti-crease cycle is dependent on the amount of laundry preset by a user and/or the amount of laundry determined by the device, it is achieved that the laundry is only agitated sufficiently during the anti-crease cycle to avoid crease formation. As a result, the laundry is only minimally agitated or loosened during the anti-crease cycle and thus is treated very gently, whereby crease formation can be optimally avoided. Furthermore, the motor for turning the drum is switched on and off less frequently, and especially towards the end of the anti-crease cycle, the switch-on time of the drum movement is reduced substantially so that the components for the drum movement such as the motor, relays for switching the motor on and off and the drum bearing are less stressed and thus the lifetime and the reliability of the device is increased. Furthermore, energy is saved since the overall switch-on time of the drum movement during and in the course of the anti-crease cycle is substantially reduced.

[024] Since the laundry temperature and also the residual moisture is still elevated at the beginning of the anti-crease cycle, the risk of creases being fixed in the laundry is higher at the beginning of the anti-crease cycle than towards the end of the anti-crease cycle so that for optimal avoidance of crease formation, a higher proportion of agitation of the laundry is required at the beginning of the anti-crease cycle than towards the end of the anti-crease cycle. Furthermore, the proportion of agitation can be optimally matched to the pre-selected drying program or to the pre-selected degree of drying or the pre-selected type of laundry. For example, a "damp for ironing" drying program requires an overall higher proportion of agitation than a "closet-dry" or "very dry" drying program. In addition, the proportion of agitation can be optimally matched to the quantity of laundry located in the drum. Thus, the proportion of agitation of the laundry can be minimized for each operating state so that the laundry and the components of the device are treated gently and the energy consumption is reduced.

[025] Consequently, in order to achieve these aims the agitation of the laundry during the anti-crease cycle is therefore dependent on measured quantities and parameters which are detected in preceding phases of a drying program and/or during the anti-crease cycle.

[026] In this case, measured quantities and parameters which are detected during a heating-up phase at the beginning of a drying program and/or during a cooling-down phase at the end of the drying program can also be taken into account.

[027] In order to achieve the preceding aims in particular, the quantity of laundry and/or the heating-up time and/or the laundry moisture and/or the laundry moisture profile and/or the laundry specific conductance and/or the profile of the laundry specific conductance and/or the moisture content and/or the moisture profile and/or the temperature of the laundry and/or the temperature profile of the laundry and/or the temperature of the drying air and/or the temperature profile of the drying air in the drum of the dryer and/or the comparison of the moisture content and/or the moisture profile and/or the temperature of the drying air and/or the temperature profile of the drying air in the drum of the dryer between entry into the drum and exit from the drum and/or the time before reaching a drying target can thus be used as measured quantities or parameters.

[028] For this purpose, the rotatable drum has rotary movement time intervals and stoppage time intervals in the anti-crease cycle. During the rotary movement time intervals the drum can be turned in one direction of rotation and/or reversingly in different directions of rotation. The duration of an anti-crease cycle is preferably one to five hours.

[029] In a preferred embodiment, the duration of the anti-crease cycle is preferably divided into four time intervals wherein in a first time interval the proportions of agitation lie between 20% and 90%, and that in a second time interval the proportions of agitation lie between 10% and 70%, and in a third time interval the proportions of agitation lie between 1% and 60% and that in a fourth time interval the proportions of agitation lie between 1% and 30%. In particular, in a first time interval the drum agitation is switched off for 104 s and switched on

for 16 s and in a second time interval the drum agitation is switched off for 284 s and switched on for 16 s and in a third time interval the drum agitation is switched off for 584 s and switched on for 16 s, and in a fourth time interval the drum agitation is switched off for 584 s and switched on for 16 s.

[030] In a method for drying laundry in a device comprising a rotatable drum (2) for agitating the laundry, following a drying program an anti-crease cycle is provided wherein the laundry is intermittently agitated. This anti-crease cycle is used to avoid fixing of creases in the laundry by regular loosening of the laundry. In order to save energy and treat the laundry and the device gently, the laundry is agitated minimally in the course of the anti-crease cycle so that crease formation is avoided.